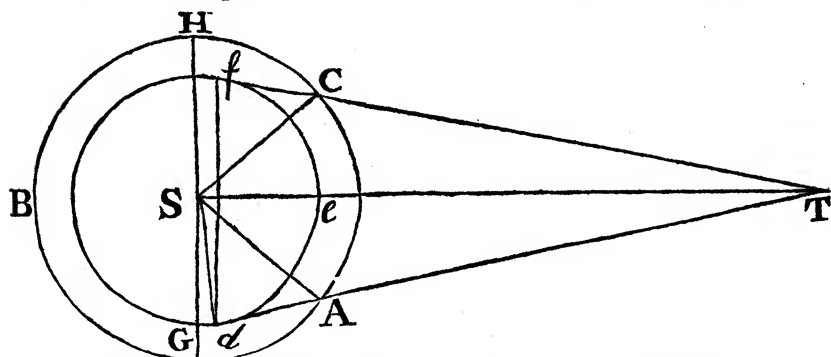


XXXVIII. *An Attempt to determine the Height of the Sun's Atmosphere from the Height of the Solar Spots above the Sun's Surface: In a Letter to Mr. J. Ellicot, F. R. S. from the Rev. Mr. Horfeley, F. R. S.*

Read July 9, 1767. **I** Return you many thanks for your obliging communication of the observations of the late transit of Venus by Mayer and Rohlius. The phænomena which they relate of the atmosphere of that planet are highly curious. They were perhaps the more interesting to me, as they confirmed some conjectures of my own, concerning the great height of the atmosphere of the sun, and of those of the two nearer planets. I once attempted to make a rough comparison between the height of the sun's atmosphere and that of our own, by comparing the height of the solar spots above the surface of the sun with that of our clouds above the surface of the earth, which I did in the following manner.

The inclination of the Sun's equator to the place of the earth's orbit is so small, that in this enquiry I think it may safely be neglected; and I consider the two planes as one. Let  $T$  be the center of the earth,  $S$  that of the Sun. Join  $TS$ , and let  $def$  be a great circle of the sun's sphere, formed by the intersector of the plane of the earth's orbit with the sun's surface.

face. Let  $ABC$  be the circle described by the revolution of a spot. From  $T$  draw  $Tf$  and  $Td$  touch-



ing the circle  $def$  in  $f$  and  $d$ , and cutting  $ABC$ , in  $C$  and  $A$ . Join  $df$ ; through  $S$  draw  $HSG$ , parallel to  $df$ . Join  $SC$ ,  $SA$ ,  $Sd$ . The spots are hid behind the sun three days longer than they are visible. That is, they are hid 15 days, and are seen only 12. The earth's motion in 15 day is  $14^{\circ} 17'$ . The spots traverse the like area in 1 d. 0 h. 50' nearly. Hence, if the earth stood still, the spots would be hid only 13 d. 23 h. 10', and their whole sidereal period being 25 d. 5 h. they would be visible 11 d. 5 h. 50', and the time of their occultation would exceed the time of their appearance by 2 d. 17 h. 20'. Hence the arc  $AC$  is less than the arc  $ABC$ , by the motion of 2 d. 17 h. 20', that is, by  $38^{\circ} 52' 56''$ . And the semi-circle being a mean arithmetic between  $AC$  and  $ABC$ ,  $AC$  will be less than the semi-circle by half as much; that is, by  $19^{\circ} 26' 28''$ . Hence each of the angles  $GSA$ ,  $HSC$  is  $9^{\circ} 43' 14''$ . The angle  $bsd = dTS = 16' 1'' 27'''$ . Therefore  $dSA$  is  $9^{\circ} 27' 12''$ . Hence  $SA = 1,013,767$  such parts as  $Sd$  is 1.

The

The distance therefore of these spots from the center of the sun is 1,013767 semi-diameters of the sun, and their distance from his surface is in decimal parts of his semi-diameter ,013767. Hence it is evident that the height of the solar spots above the surface of the sun, is above 54 such parts, as bear each to the sun's semi-diameter, the proportion of one Paris mile to the semi-diameter of the earth, which is that of 1 to 3923 nearly. The height of our atmosphere is generally reckoned about 50 miles. That of the lightest clouds fall short of one mile. The whole height of our atmosphere therefore is, at least, 50 times that of our highest clouds. If the whole height of the sun's atmosphere bear as large a proportion to the height of these solar spots or clouds (and I think the proportion is likely to be much larger), the height of the sun's atmosphere is not less in proportion to his semi-diameter, than 54 times that of the earth's, and exceeds two thirds of his semi-diameter, being in decimal parts thereof ,68835.

The probability seems to be that the height of the sun's atmosphere is almost double of this; for I question whether the mean height of our clouds exceeds  $\frac{1}{2}$  a Paris mile. The solar spots, therefore, are 108 times as high in proportion; and then, supposing as before, that the whole height of the sun's atmosphere bears the same proportion to the height of his spots, as the whole height of our atmosphere to the mean height of our clouds, the sun's atmosphere will be 108 times as high in proportion to his semi-diameter as ours is, and will rise

to the distance of more than  $\frac{4}{3}$  of his semi-diameter from his surface.

Let philosophers consider, whether these indications of the vast height of the sun's atmosphere give any degree of probability to a conjecture of Sir Isaac Newton's, that the dissipation of the sun's substance, which might be expected to ensue from his intense heat, may in great part be prevented by the prodigious pressure of the incumbent atmosphere.

The height of the atmosphere of Venus is considerably greater according to the observations of Mayer and Rohlius than they imagined. Rohlius follows Cassini in the estimation of the sun's apogee semi-diameter, which Cassini over rated by  $3'' 45'''$ . This quantity, therefore, is to be added to the height of Venus's atmosphere (15,5) as stated by Rohlius; which makes the true height  $19''.25$ , that is above  $\frac{1}{3}$  of the diameter of the planet. I cannot but reflect with some degree of national triumph on the great part that our own country may justly claim in many of the most curious discoveries in all parts of the world. Mr. Meyer generously confesses how much he stood indebted to English artists. You told me that it is your intention to present that curious tract to the Royal Society. You may likewise communicate this if you think it contains any thing worthy of their notice.

I am, Sir, with great esteem,

Your most obedient

and most humble servant,

Broad-Street,  
June 11, 1767.

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Sam. Horsley.  
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